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## Structural breaks and external shocks in the Malaysian economy

### Abstract

The Malaysian economy has undergone rapid economic growth and structural change over the past four decades.

### Keywords

Structural, Breaks, External, Shocks, Malaysian, Economy

### Disciplines

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# Structural Breaks and External Shocks in the Malaysian Economy

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*The Malaysian economy has undergone rapid economic growth and structural change over the last four decades. It has been the second fastest growing economy in ASEAN after Singapore but has been vulnerable to external shocks, which has created booms and butts in the Malaysian economy. This paper employs annual time series data (1960-2003) and the ZA (Zivot and Andrews, 1992) and the LP (Lumsdaine and Papell, 1997) approaches to determine endogenously the more likely time of major structural breaks in various macroeconomic variables of the Malaysian economy. The results from employing the ZA methodology, which indicate the existence of one structural break for each macroeconomic variable, show the null of at least one unit root cannot be rejected. However, the results of the LP methodology in the presence of multiple structural breaks indicate that two out of the eight variables under investigation became stationary. The endogenously determined structural breaks coincides with the periods of external shocks to the Malaysian economy, that is the first and second oil shocks in 1974 and 1980 respectively; the commodity boom in 1979; the economic recession in 1985-86; the decline in FDI in 1993 and finally, the East Asian financial crisis in 1997.*

**JEL classification numbers:** C12, C22, C52.

**Key words:** Structural break, unit root test, and Malaysian economy.

## I. Introduction

The Malaysian economy has undergone rapid growth and structural change over the past more than four decades from 1960 to 2003. In the 1960s, Malaysia was primarily an agrarian economy relying on the exports of primary commodities such as rubber, tin and palm oil for export earnings to generate income and employment. Over the period, the GDP of Malaysia grew by an annual average rate of 6 percent per annum (Ministry of Finance, 2003). During the 1970s, Malaysia started to experience severe economic downturn caused largely by reduction in commodity prices. For example, in 1974, the price of rubber, palm oil and cocoa dropped severely. The drop in the price of petroleum in 1979 further exacerbated this problem. In addition, mismanagement of many government enterprises in the 1970s and the early 1980s further contributed to economic downfall in Malaysia. In 1985, Malaysia experienced severe economic

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recession with negative 1.2 percent GDP growth (MIER, 2000). In 1985, the terms of trade declined by 4.5 percent and further to 14.9 percent in 1986. This subsequently resulted in huge balance of payments problem (Government of Malaysia, Sixth Malaysian Plan, 1991-1995).

To counter these problems, the government introduced various remedial economic policies ranging from privatization of state owned enterprises (SOEs), liberalization of the financial market and the implementation of the First Industrial Master Plan (IMPI) in 1986. In this plan, the government placed emphasis on the growth of the manufacturing sector instead of the agriculture sector. Specific focus was given on inducing foreign direct investment into core economic sectors with liberalization of the foreign equity ownership policy from 10 percent to 20 percent. These efforts generated quick and high FDI inflows into the country. Over the period 1986 to 1990, the manufacturing sector registered a positive growth rate of 13.4 percent (Ministry of Finance, Economic Report, 1999).

Subsequently over the period 1986 to 1997, Malaysia experienced sustainable economic expansion with an annual average growth rate of 7 percent per annum. While internal economic fundamentals remained strong during this period, the external economic factors had significant impact on Malaysia. The speculative assault on the Thai currency in July 1997 had a deteriorating impact on the Malaysian currency. Massive outflows of capital was seen in South East Asia including Malaysia. The financial crisis destabilized the country's socio-economy development with the currency depreciating by 30 percent and the Kuala Lumpur Stock Exchange plummeting by more than 50 percent (Ariff, 1998). The GDP grew only by 1.6 percent in 1998. Overall, the crisis had cost Malaysia a total of RM200 billion in terms of the purchasing power of imports and RM600 billion in terms of market capitalization (The Edge, 2001).

To mitigate this problem, the government undertook major economic revitalizing efforts such as the pegging of the Malaysian Ringgit to the US dollar, capital controls, halting several mega projects (e.g. the Bakun Dam project) and the establishment of the National Economic Action Council (NEAC). The NEAC helped to draw strategic measures in countering the economic downturn. By early 1999, the country saw an upturn in the economy and registered a positive annual growth rate of 5.4 per cent (Government of Malaysia, Eight Malaysian Plan, 2001-2005).

In recent years, Malaysia's economy continued to record creditable performance, despite the unprecedented volatility in the global economy as well as uncertainties introduced by international terrorism (eruption of war in Afghanistan and Iraq) and the outbreak of the Severe Acute Respiratory Syndrome (SARS) epidemic in early 2003. In May 2003, the government launched the Package of New Strategies to stimulate further the economy, with specific focus on generalizing domestic sources of growth, promoting private investment and strengthening the country's competitiveness.

The objective of this paper is to identify major structural breaks in the various selected dominant macroeconomic variables of the Malaysian economy using annual time series data (1960-2003). The structure of the rest of the paper is as follows: Section II uses the ZA method to test the unit root hypothesis assuming one major unknown structural break. Following LP (1997) and Ben-David, Lumsdaine and Papell (2003), Section III reports the times of the two data-dependent structural breaks, which are determined by a recursive, rolling or sequential approach, in each of the variables analysed in the paper. Section IV presents some concluding remarks.

## **II. Zivot And Andrews Unit Root Test With One Structural Break**

It is argued that the conventional unit root tests can have little power when the true data generating process of a broken linear trend is stationary. According to Perron (1989; 1997), failing to account for at least one time structural break in the trend function, may bias the usual unit root results towards their non-rejection of the null. In other words, tests such as the ADF test or the Phillips-Perron test may incorrectly indicate that there is a unit root in a series, whereas in actual fact this series can be stationary around a one-time structural break (ZA, 1992).

It should be noted, however, that Perron (1989) applied his procedure assuming or visually detecting a particular year as the starting point for the structural break. The assumption of a known break is subject to a criticism as one may choose a particular date, which conforms with his or her results by resorting to pre-testing and data-mining. Furthermore, a particular event may have occurred in time  $t$  but its gradual effects would not eventuate until subsequent years. New studies now endogenise the time of structural breaks. These procedures involve the estimation of the break point in an iterative process. There is a significant difference between the ZA method and the

Perron's test. In ZA method, the time break is estimated compared to the assumption made in the Perron's test.

Further, in the Perron(1989) test, the null hypothesis states that the variable under investigation contains a unit-root with a drift that excludes any structural break. Meanwhile, the alternative hypothesis states that the series is a trend stationary process with a one-time break in the trend variable occurring at an unknown point in time. The alternative hypothesis in the ZA method is more general and allows for shifts in the level or the growth rate of the series. The ZA method runs a regression for every possible break date sequentially. By endogenously determining the time of structural breaks, ZA argue that the results of the unit root hypothesis previously suggested by earlier conventional tests such as the ADF test may be reversed. In ZA, the  $TB$  (the time of break) is chosen to minimize the one-sided  $t$ -statistic of  $\alpha=1$  in equations 3 to 5 below or  $\alpha_2=1$  in equation 1.

In other words, a break point is selected which is the least favorable to the null hypothesis. The ZA model endogenises one structural break in a series (such as  $y_t$ ) as follows:

$$\begin{aligned} H0: & y_t = \mu + y_{t-1} + e_t \\ H1: & \end{aligned} \quad (2)$$

Model A

$$y_t = \hat{\mu}^A + \hat{\theta}^A DU_t(\hat{T}_b) + \hat{\beta}^A t + \hat{\alpha}^A y_{t-1} + \sum_{j=1}^k \hat{c}_j^A \Delta y_{t-j} + \hat{e}_t \quad (3)$$

Model B

$$y_t = \hat{\mu}^B + \hat{\beta}^B t + \hat{\gamma}^B DT_t(\hat{T}_b) + \hat{\alpha}^B y_{t-1} + \sum_{j=1}^k \hat{c}_j^B \Delta y_{t-j} + \hat{e}_t \quad (4)$$

Model C

$$y_t = \hat{\mu}^C + \hat{\theta}^C DU_t(\hat{T}_b) + \hat{\beta}^C t + \hat{\gamma}^C DT_t(\hat{T}_b) + \hat{\alpha}^C y_{t-1} + \sum_{j=1}^k \hat{c}_j^C \Delta y_{t-j} + \hat{e}_t \quad (5)$$

Model A allows for a one-time change in the intercept. Model B is used to test for stationarity of the series around a broken trend and finally Model C accommodates the possibility of a change in the intercept as well as a broken trend.  $DU_t$  is a sustained dummy variable capturing a shift in the intercept, and  $DT_t$  is another dummy variable representing a shift in the trend occurring at time  $TB$ . The alternative hypothesis is that the series,  $y_t$ , is  $I(0)$  with one structural break.  $TB$  is the break date, and  $DU_t=1$  if  $t >$

$TB$ , and zero otherwise,  $DT_t$  is equal to  $(t-TB)$  if  $(t > TB)$  and zero otherwise. The null is rejected if  $\alpha$  coefficient is statistically significant.

More specifically, the ZA test asserts that  $TB$  is endogenously estimated by running the three equations (models A, B and C) stated above. This is done sequentially in order to allow for  $TB$  to be in any particular year with exception for the first and the last years. The optimal lag length is determined on the basis of the SBC. Using the ZA procedure, the time of the structural changes (impacting on both the intercept and the slope of each series) for each of the eight variables is detected based on the most significant  $t$  ratio for  $\hat{\alpha}$ , that is  $t_{\hat{\alpha}}$  and the results are presented in Figure 1 and Table 1.

**Table 1. The Zivot-Andrews test results: break in both intercept and trend (model C)**

Variable		$TB$	$K$	$t_{\hat{\alpha}}$	Inference	Correspond break time
Description	Symbol					
Consumer price index	$Ln(CPI)$	1973	1	-4.387	Unit root	1973-75 oil shock
Official exchange rate (Ringgit per \$US)	$Ln(OER)$	1986	0	-4.197	Unit root	Unofficial devaluation of the Ringgit
Real gross domestic Product	$Ln(GDP)$	1976	1	-3.585	Unit root	Commodity export boom
Real private consumption	$Ln(PC)$	1980	1	-4.695	Unit root	Second oil shock
Real government consumption	$Ln(GC)$	1977	0	-3.266	Unit root	Expansionary fiscal policy
Real gross fixed capital formation	$Ln(GFCF)$	1993	1	-3.401	Unit root	World recession (decline in FDI)
Real total exports	$Ln(X)$	1973	0	-3.844	Unit root	1973 export boom
Real total imports	$Ln(IM)$	1978	1	-3.302	Unit root	Higher import Prices

Notes: (1) Critical Values at 1, 5 and 10% levels are -5.57, -5.08 and -4.82, respectively (Zivot and Andrews, 1992). (2) The optimal lag length ( $k$ ) is determined by SBC. (3) Sources: The data for these 8 variables collected from World Bank, IFS (2004)

Results from the ZA test shows that all the eight variables examined in this paper are non-stationary. The corresponding time of the structural break ( $TB$ ) for each variable is shown in the last column of the Table 1. We observe that the one time structural break for the variables  $Ln(CPI)$ ,  $Ln(GDP)$ ,  $Ln(PC)$  and  $Ln(X)$  occurred in the years 1973, 1976 and 1980, which are also the years when the global oil shock

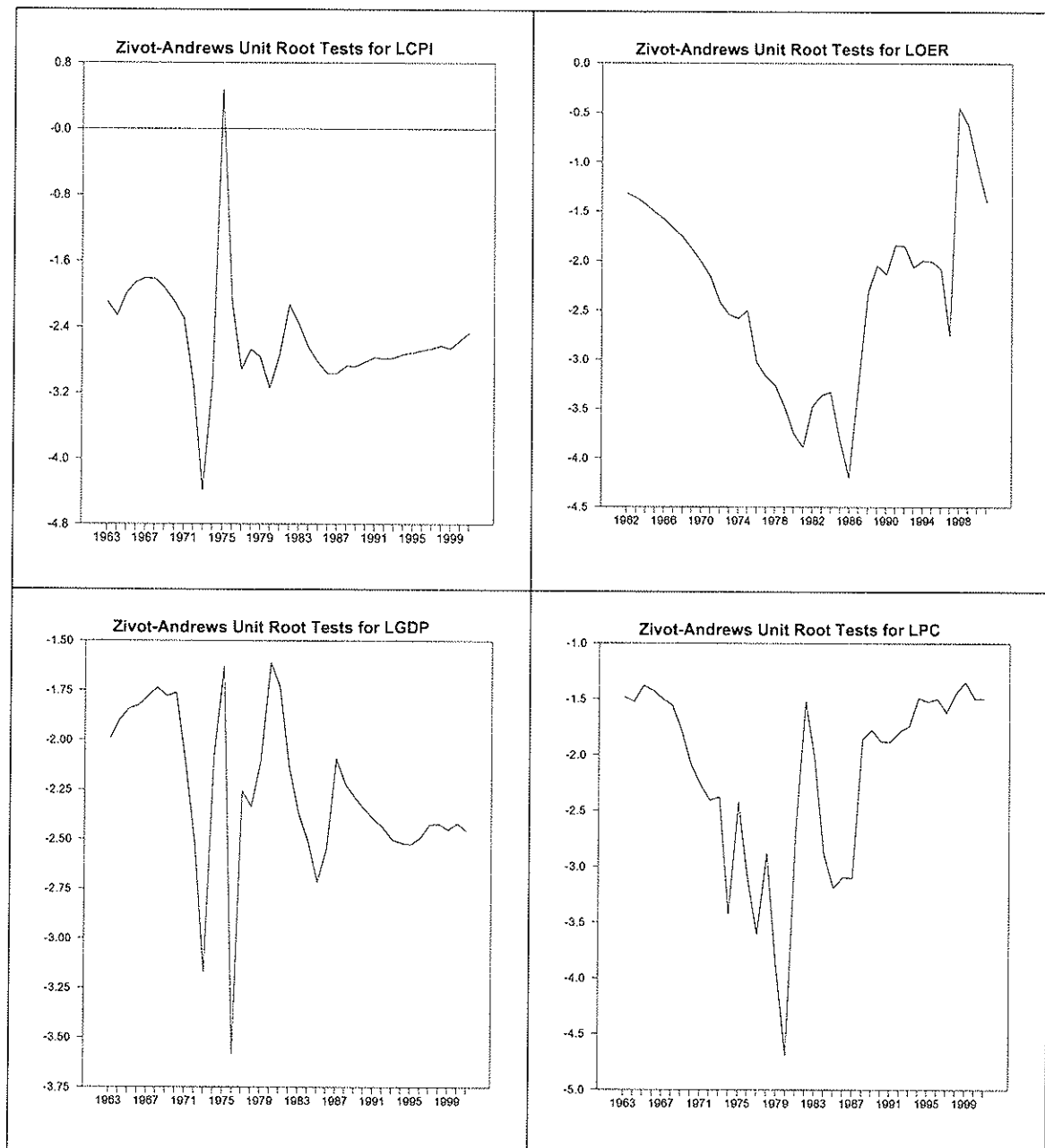
occurred. In addition, the structural break for  $Ln(CPI)$  occurred in 1973 probably because the Malaysian economy experienced double-digit inflation as a result of the sharp increase in the price of imports and stagnating output. The imports were necessary, as Malaysia had moved aggressively to an export oriented industrialization strategy as import substitution had reached its limits in a small economy.

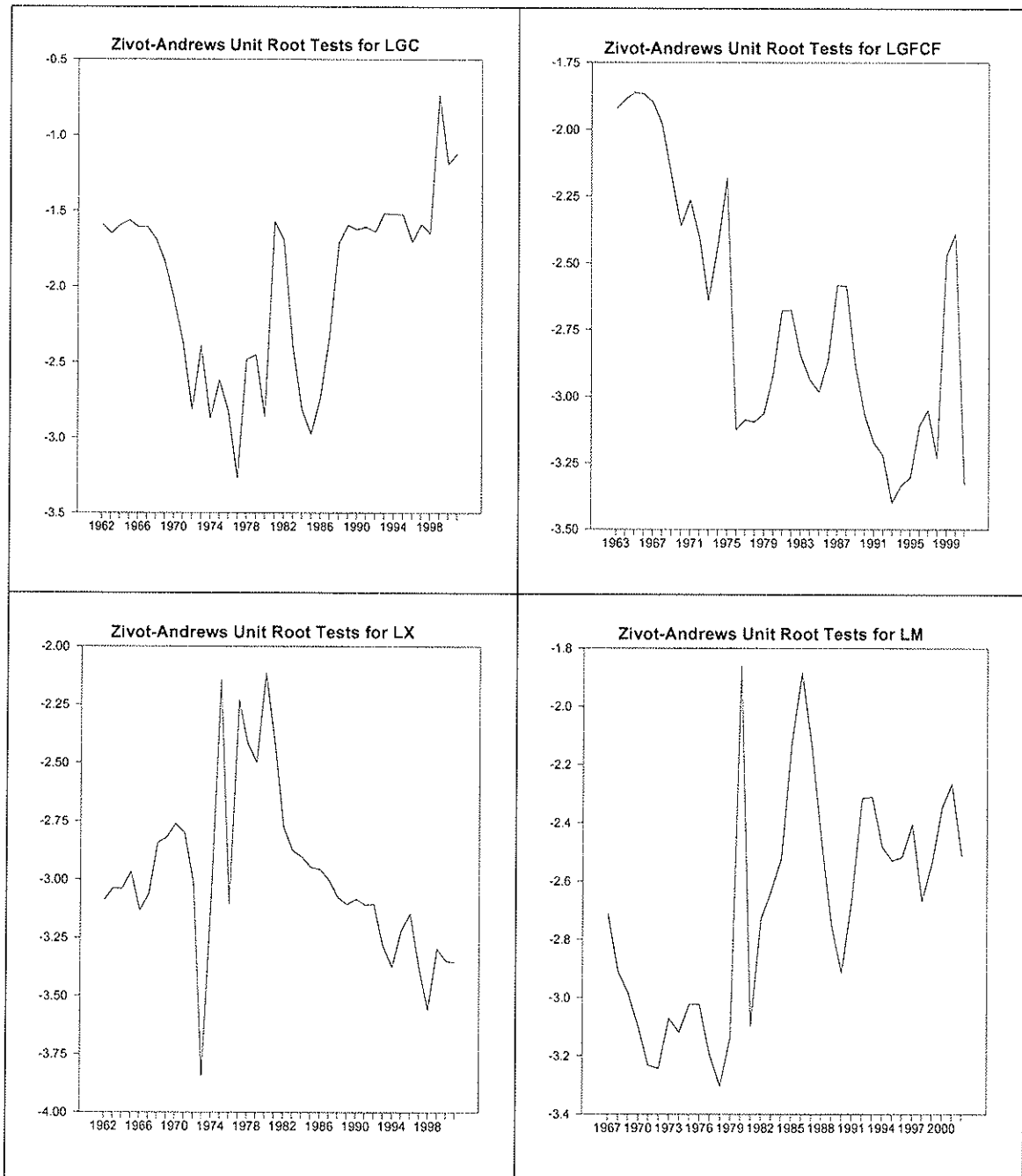
The structural break for the variable  $Ln(OER)$  occurred in the year 1986 which coincided with the introduction of more generous incentives to attract a greater inflow of Foreign Direct Investment (FDI) in the export oriented industries. Part of the effort to increase the international competitiveness of Malaysia was to allow the exchange rate to depreciate to reduce the cost of labor and the cost of doing business in Malaysia. The government departed from its previous policy of defending the Ringgit within a narrow band because primary commodity prices collapsed in 1985, creating massive unemployment and a negative growth rate for the first time, which also increased the debt burden and losses made by many state enterprises.

The structural break for the variable  $Ln(GC)$  occurred in 1977 as the Malaysian government embarked on an expansionary fiscal policy to redistribute wealth more aggressively to attain the objectives of the New Economic Policy and to stimulate the domestic economy as the rate of growth of exports had begun to decline (Economic Report, 1981/1982). The structural break for the variable  $Ln(IM)$  occurred in 1978 as import prices began to increase and there was a commitment to increase intermediate and capital goods to support industrialization. As a result there was a sharp increase in the import bill. Finally, the structural break for variable  $Ln(GFCF)$  occurred in 1993, a period that was negatively affected by global recession as the rates of economic growth in the advanced countries that were Malaysia's major trading partners began to decline (Economic Report, 1993/1994). This was followed by a massive drop in the FDI in Malaysia as Malaysia's major trading partners were also its major source of FDI.



**Figure 1. Plots of the estimated timing of structural breaks by ZA procedure allowing for a break in both intercept and trend(model C)**





Source: Authors' calculations based on the ZA procedure (model C).

Note: the numbers on the vertical axis are  $\hat{t}_\alpha$  ratios. The minimum t-ratio determines  $TB$ .

### III. Unit Root With Two Structural Breaks

As noted earlier, the ZA test captures only one (the most significant) structural break in each variable. What if, there have been multiple structural breaks in a series? Considering only one endogenous break may not be sufficient and it could lead to a loss of information particularly when in reality there is more than one break (LP,

1997). On this same issue, Ben-David *et al.* argued that “just as failure to allow one break can cause non-rejection of the unit root null by the Augmented –Dickey –Fuller test, failure to allow for two breaks, if they exist, can cause non-rejection of the unit root null by the tests which only incorporate one break” (2003: 304). A new approach to capture structural break was introduced by LP with the argument that a unit root test that shows two structural breaks is much more robust. LP uses a modified version of the ADF test which specifies two endogenous breaks as follows:

$$\Delta x_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha x_{t-1} + \sum_{i=1}^K c_i \Delta x_{t-i} + e_t \quad (6)$$

Where  $DU1_t=1$  if  $t>TB1$  and otherwise zero;  $DU2_t=1$  if  $t>TB2$  and otherwise zero;  $DT1_t= t-TB1$  if  $t>TB1$  and otherwise zero; and finally  $DT2_t=t-TB2$  if  $t>TB2$  and otherwise zero. Estimation of two structural breaks can be done in both the time trend and the intercept known as TB1 and TB2. The breaks in the intercept are shown in equation (6) by  $DU1_t$  and  $DU2_t$ , respectively, whereas the slope changes (or shifts in the trend) are represented by  $DT1_t$  and  $DT2_t$ .

Determination of the optimal lag length ( $k$ ) is based on the general to specific approach suggested by Ng and Perron (1995). The result for the LP test is given in Table 2. If we look at the first variable in Table 2, we find that using the LP model the structural breaks for  $Ln(CPI)$  occur in 1976 and 1982. In 1976 there was inflation because of increasing prices of imports and in 1982 the inflation was due to expansionary fiscal policy as the government accelerated the process of filling vacancies in the civil service or public bureaucracy. In the case of  $Ln(OER)$  the structural breaks occur in 1980 and 1997. The official exchange rate depreciated in 1980 as commodity prices began to decline and they depreciated even further in 1997 due to the speculative attack on the Malaysian Ringgit.

Using the the LP model there are two breaks in  $Ln(GDP)$  in 1976 and 1985. The first break is coincide with the effect of commodity export boom in 1976 and second endogenously determined break by LP method identifies the negative rate of GDP growth in 1986 as a result of the collapse of commodity prices. Two structural breaks in  $ln(PC)$  occurred in 1977 and 1980. The earlier break in 1977 may be due to the expansionary fiscal policy adopted by the government to stimulate the economy and second break is coincide with the effect of the second oil boom in 1980.

**Table 2. The Lumsdaine and Papell test results: break in both intercept and trend**

Description	Symbol	<i>K</i>	<i>TB1</i>	<i>TB2</i>	<i>t</i> -statistic for $\alpha$	Correspond break time
Consumer price index	$Ln(CPI)$	8	1976	1982	-6.339	TB1: Commodity export boom TB2: Expansionary fiscal policy
Official exchange rate	$Ln(OER)$	8	1980	1997	-7.453*	TB1: Second oil shock TB2: Asian financial crisis
Real gross domestic Product	$Ln(GDP)$	5	1976	1985	-4.867	TB1: Commodity export boom TB2: Recession
Real private consumption	$Ln(PC)$	5	1977	1980	-7.997*	TB1: Expansionary fiscal policy TB2: Second oil shock
Real government consumption	$Ln(GC)$	4	1980	1997	-6.152	TB1: Expansionary fiscal policy TB2: Asian financial crisis
Real gross fixed capital formation	$Ln(GFCF)$	3	1975	1997	-4.981	TB1: Second oil shock TB2: Asian financial crisis
Real total exports	$Ln(X)$	8	1974	1998	-6.071	TB1: Oil shock TB2: Export boom
Real total imports	$Ln(M)$	6	1974	1985	-4.644	TB1: Oil shock TB2: Economic recession

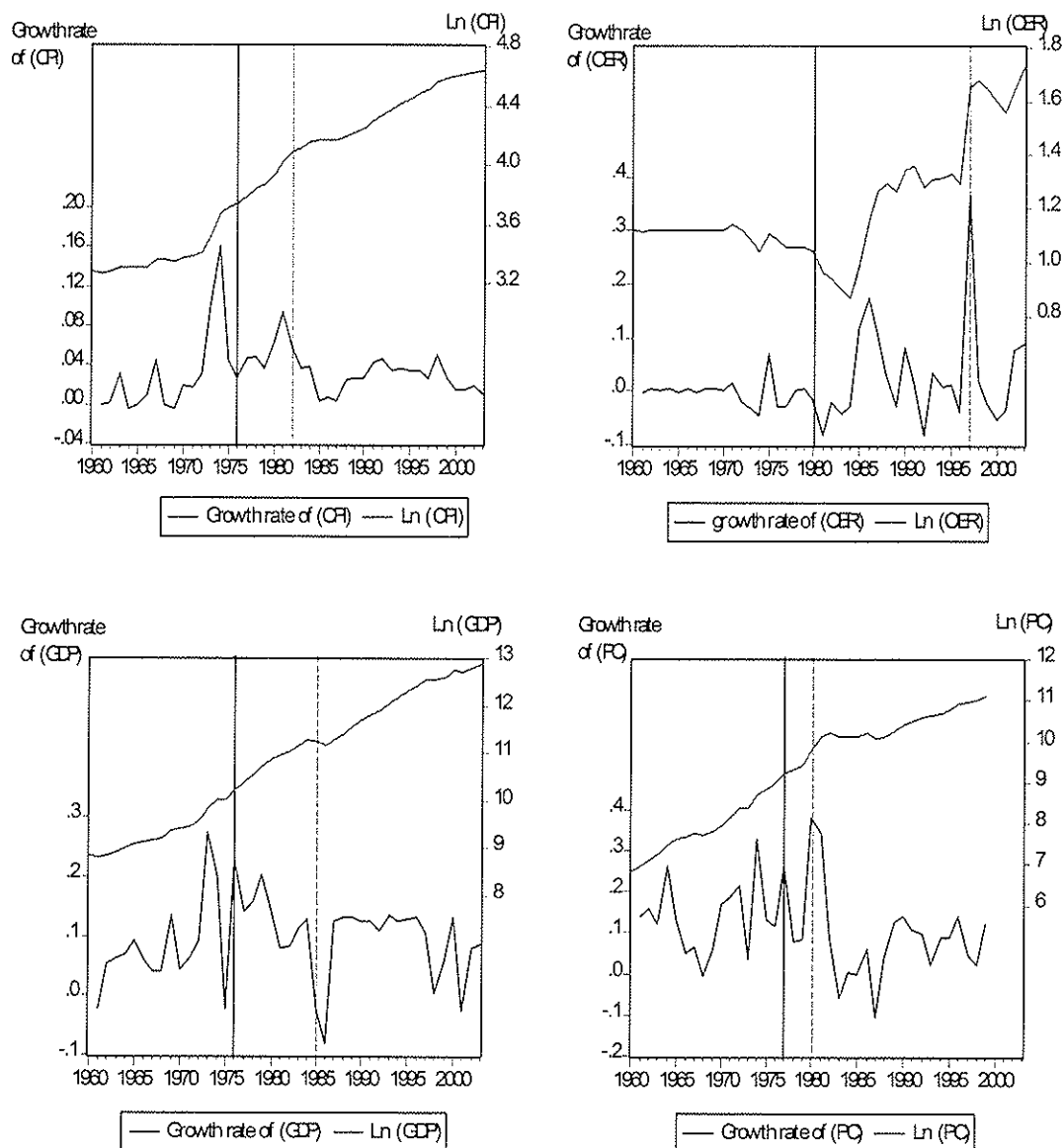
Notes: (1) \* Indicates that the corresponding null is rejected at the 5 % level. (2) The optimal lag length (*k*) is determined by the general to specific method (the *t* test). (3) The data for these 8 variables collected from World Bank, IFS (2004)

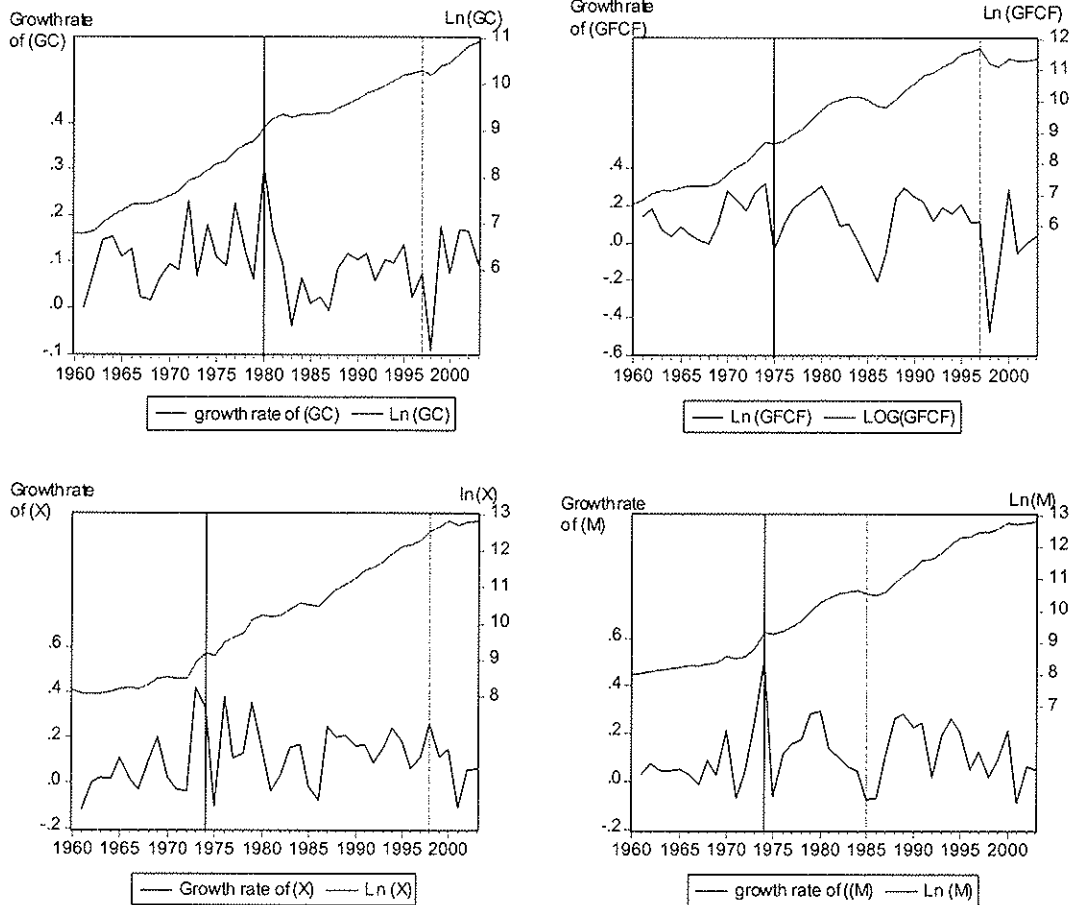
Two endogenously determined breaks in the  $\ln(GC)$  variable occurred at 1980 and 1997. These two breaks coincide with the period of expansionary fiscal policy to fill vacancies and create jobs (and also the second oil shock) in 1980 and the vast expansion in infrastructure in 1997 which is also coinciding with the effect of Asian crisis. Using the LP model there are two breaks in  $\ln(X)$ , that is, in 1974 and 1998. The LP results indicate that the export boom in 1973 was sustained in 1974 and export growth recovered in 1998 after the 1997 East Asian financial crisis. Finally, the LP model shows that two structural breaks in the  $\ln(M)$  variable occurred in 1974 and 1985. The first break in imports is coincide with the 1973-74 oil shock. Moreover, In 1985 (TB2), the deep recession as a result of the sharp fall in prices caused the Ringgit to depreciate and import prices to rise.

Figure 2 shows the log level and the growth rate of each of the eight variables employed as well as their corresponding two LP structural breaks- the solid line denotes *TB1* and a dashed line is used to point to *TB2*. A cursory look at Figure 2 also

show that the resulting break dates for the variables under investigation obviously coincide with major turning points in the intercept and/or the trend of the variables under investigation.

**Figure 2. Plots of the series and endogenously estimated timing of structural breaks by Lumsdaine and Papell test**





Source: International Monetary Fund (2004), *International Financial Statistics*, (<http://ifs.apdi.net/imf/logon.aspx>), IMF, Washington, D.C.

#### IV. Conclusion

The aim of the paper was to identify the time of the major breaks in key macroeconomic variables of the Malaysian economy by utilizing annual time series data over the period of 1960-2003. In order to achieve the objective of the paper, we utilized the ZA(Zivot and Andrews,1992) approach to allow the data to determine the single most important structural break in each series. This paper applies also the LP(Lumsdaine and Papell,1997) procedure to determine a model which accommodate two significant structural breaks in the time series data. This paper found that according to the ZA test none of the variables under investigation is stationary. However, after considering two structural breaks, the LP test results show that the unit root null hypothesis is rejected at the 10 or 5 per cent levels for two out of the eight variables under investigation. Most of the structural changes are associated with the first and second oil shocks, which occurred in 1973 and 1980 respectively; the deep

recession in 1985-1986 and the adverse effects of the 1997 East Asian currency crisis on the Malaysian Ringgit and the real economy of Malaysia.

A significant feature of this article is that it has highlighted that the ZA and LP methodologies can be usefully applied to time series data to identify major structural breaks in key macroeconomic variables for Malaysia that are realistic and that can be explained by complimentary qualitative evidence. However, the two different methodologies employed yield different structural breaks for most of the variables. Further research needs to be done to further explore the implications of these different results. Since testing for nonstationarity with multiple structural breaks may yield conflicting results to conventional unit root tests, future work could also concentrate on such clear refinements.

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